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ABSTRACT

Studies conducted by the United States Military Academy and Air Force Academy showed that many cadets who had attended preparatory schools which prepared high school graduates for college admission performed below what had been predicted by their scores on college entrance examinations. Based on these findings, about 1,200 students from 10 preparatory schools participated in a study to determine the effect of preparatory school test coaching on college entrance examination scores and subsequent performance in college. Scores on the September, 1962 and March, 1963 Scholastic Aptitude Test (SAT) and College Board (CEEB) achievement tests in mathematics and English composition were compared. Scores were correlated with five background variables: intelligence index, number of secondary schools attended, number of mathematics and English courses, and high school rank. Both SAT and achievement test scores increased, with CEEB scores showing the greater increase. Both SAT verbal and mathematics test scores increased significantly beyond what had been considered typical for a senior high school year. Also, cadets in the military academies performed significantly poorer than was predicted by CEEB scores, as indicated by an adjusted correlation of .35. Implications of the study are discussed, and statistical analyses of aspects of the study are appended. (CP)

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STUDY NUMBER I A1.02-62-001

PREPARATORY SCHOOL TEST PREPARATION

SPECIAL TEST PREPARATION, ITS EFFECT ON COLLEGE BOARD SCORES AND THE RELATIONSHIP OF EFFECTED SCORES TO SUBSEQUENT COLLEGE PERFORMANCE

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PROJECT ADMISSION

Study No. I-A1.02-63-001

Subtask: Preparatory School

Prepared By

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Director of Admissions and Registrar

The findings in this study are not to be construed as official Department of the Army position unless so stated in the report.

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SUMMARY

1. BACKGROUND: Studies at USMA and the Air Force Academy have shown that actual academic college performance of many cadets who had taken an extra year of preparation in preparatory schools offering courses for students seeking college admission was far below that which would be predicted from their scores on College Board tests. Educational Testing Service had also expressed interest in the effects of practice over an extended period of time on College Board test taking.

2. PROBLEM: In that some educators have felt that attendances at preparatory schools are merely extensive practice periods and that these schools attract underachievers, this study was initiated to examine the effect of preparatory school examination training on college entrance examination scores and subsequent performance in college.

3. PROCEDURE: Students at ten well-known preparatory schools that specialize in preparing high school graduates for admission to college were included in the study. Students' educational backgrounds were studied with respect to schools attended and courses taken. College Board test scores were compared and relationships between these test scores and end-of-freshman-year academic performance in both the service academies and civilian colleges were studied.

4. RESULTS:

a. Summary. College Board achievement test scores of candidates after preparatory school attendance were raised far more than the College Board Scholastic Aptitude Test scores, particularly in mathematics. As a group, cadets from preparatory schools performed significantly poorer than was predicted. Academic performance of the civilian college sample tested was even poorer than that of the service academies samples. There were some significant differences among the preparatory schools, particularly with respect to length and scope of courses given.

b. Conclusions. Results of this study seem to indicate that scores on achievement tests for applicants who have attended preparatory schools offering a one-year curriculum ought to be tempered or an adjustment made in the weights assigned to scores obtained. Such an adjustment can be easily determined by statistical procedures to increase the accuracy with which academic success is predicted.

c. Recommendations.

(1) Those preparatory schools offering one-year curriculums for boys seeking admission to college would assist the student most if they would gear their curriculums to the freshman college level.

(2) Preparatory schools should adopt a policy of requiring students to stay on until the end of May rather than terminating their training in January or March after the administration of the College Board tests. Such a procedure should enhance the student's college performance during freshman year.

(3) Since attendance at a preparatory school suggests a high motivation to enter the United States Military Academy, a study of Aptitude for the Service Rating scores and resignation rates of cadets and graduates who had attended a preparatory school is indicated.

SPECIAL TEST PREPARATION, ITS EFFECT ON COLLEGE BOARD SCORES AND THE RELATIONSHIP OF EFFECTED SCORES TO SUBSEQUENT COLLEGE PERFORMANCE[1]

Introduction

Studies at both the United States Air Force Academy and the United States Military Academy have shown that the actual college performance of many cadets who had taken an extra year of preparation in prep schools having one-year curriculums for students seeking college admission was far below what was predicted from their scores on one or more of the College Board tests. Such students might normally be classified as underachievers if it were not known that they attended schools whose primary purpose for existence is to enable the applicant to gain admission to college. It is to be expected that emphasis would be placed on the content of those tests commonly used by the colleges as aids in determining the qualifications of their applicants. In fact, in some of the schools in this study, the March College Board examinations constitute the final exams, while in others, a large majority of the students leave the school after the March examinations even though the school has a curriculum continuing to May by way of additional preparation for college work.

Several studies on the effect of practice on College Board test scores have been carried out at ETS or under the auspices of the College Boards.(1) All of them were carried out on the SAT tests, and all of them were concerned with the effect of practice as such; e.g., one or two hours of practice per week over periods of time varying from six weeks to six months. Practice is herein defined as a concentrated and systematic study of test items comparable to those found in the College Board tests or material prepared in the form of test items as they are presented in the College Board tests, the rationale for such an approach being that the student not only learns the material but also gains in test-taking ability. No significant improvement in test scores due to practice was found by any of the studies.

There is some question as to just what six months of full-time exposure to course content that is directly related to the verbal and mathematics College Board tests (both Aptitude and Achievement) should be called. It could well be considered an extra secondary school year as a result of which a normal year's growth would be expected. On the other hand, it could be considered as simply an intensive practice period.

If the scores obtained on the College Board tests after attendance at a prep school were true reflections of the individual's ability to perform college work -- or at least as true as such scores are for secondary school

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[1]This investigation was supported in part by the College Entrance Examination Board both through a research grant and by providing tests and test scoring facilities.

seniors -- one would expect such scores to be as valid for predicting the college performance of the former as for the latter. The test of the validity of such scores then must consist in the accuracy with which they predict college performance.

If upon subsequent validation, those who attended coaching schools perform far below what was predicted from their test scores, there are two conclusions that can be drawn: (a) that the prep schools are nothing but intensive practice periods, inflating test scores far above the predicted subsequent actual college performance of the student; (the student is made an underachiever); or (b) that the prep schools attract the underachievers; that their final scores are true reflections of their ability but that they do not perform up to their ability due to any or all the reasons that are usually offered for underachievement. However, whether conclusion (a) or (b) is the correct one to be drawn is a moot point since in either case the scores do not reflect how the student can be expected to perform in college. The colleges recognize that they will always admit some underachievers by definition. But few colleges will admit a known underachiever over an unknown underachiever, all other things being equal.

The Sample

Eleven prep schools participated in the study. They are:

1. The Boyden School; San Diego, California
2. Braden's; Cornwall, New York
3. Bullis School; Silver Spring, Maryland
4. Columbian Preparatory School; Washington, D.C.
5. Millard School; Bandon, Oregon
6. Northwestern Prep; Minneapolis, Minnesota
7. Sullivan School; Washington, D.C.
8. U.S. Air Force Preparatory School; Colorado Springs, Colorado
9. U.S. Military Academy Preparatory School; Fort Belvoir, Virginia
10. U.S. Naval Academy Preparatory School; Bainbridge, Maryland
11. University School; Pittsburgh, Pennsylvania

There was a total of 1268 students in attendance at the eleven schools. The number in each school taking special college entrance curriculums ranged from 29 to 285.

From reports of supervisors at the test centers, the sample was reduced as follows:

a. Four female cases were dropped from the Boyden School.

b. The entire University School was dropped for the following reasons:

(1) Over 60% of the students were female -- a fact of which we were not aware at the time of contact --; and

(2) The school was not of the same type as the others. It is a four-year accredited prep school, although a large portion of the student body consists of students who lacked a sufficient number of credits to graduate from the high school attended previously. There is no special attempt to prepare the individual for the College Board tests. The school is unique in that each student is tutored privately each day in each subject for one-half hour. There is no post-graduate program as such.

Bullis and Boyden are also four-year accredited secondary schools, but they have a special post-graduate program for boys who have completed their secondary school work and are seeking admission to a college. All the other schools in the sample are non-accredited prep schools devoted exclusively to preparing high school graduates for admission to college.

After the above eliminations, the total number of students tested in September 1962 was 1206. It should be noted that of the original 1206, not all took the entire battery at any one of the National Administrations of CEEB tests, and many did not take any of the examinations in March. A summary of the actual number of tests results available from each of the test administrations is presented in Table 1.

Table 1

NUMBER OF TEST SCORES AVAILABLE FROM EACH OF FOUR ADMINISTRATIONS; THE EXPERIMENTAL ADMINISTRATION IN SEPTEMBER, 1962, AND THREE NATIONAL ADMINISTRATIONS; DECEMBER, 1962, JANUARY AND MARCH, 1963.

	September	December	January	March
A. Total Number of Students	1206	435	639	717
B. Total Number of Test Scores on:				
SAT-V	1202	434	627	714
SAT-M	1204	435	628	715
EC	1203	290	557	649
IM	1201	280	533	610
AM	903	155	268	251

Procedure

The study was initiated by the administration of a full battery of College Board tests (SAT-V, SAT-M, English Composition, Intermediate Mathematics and Advanced Mathematics)[2] at each school during the first week of school. The times of the testings were sufficiently varied to enable two teams from West Point to supervise the administration in nine of the schools. An Air Force Officer from the Air Force Academy who had experience in the College Board testing centers supervised the testing at Millard, and a College Board representative from Los Angeles supervised the administration at Boyden in San Diego.

For the study of the effect of special preparation on College Board test scores, the March administration of the CEEB tests was selected as the one from which gains in test scores were to be determined, primarily because

[2]The Advanced Mathematics test was not administered to students at the U.S. Naval Academy Prep School at the request of their administration.

it was the administration toward which the greater number of the students in the prep schools were aiming; and hence, the one toward which the curriculums of the majority of the prep schools were generally geared. However, in all of the prep schools, there were students who were also, if not primarily, interested in the January administrations. Such was the case with those students who had Competitive[3] nominations to a Service Academy. Since the number of young men seeking entrance to the academies via the competitive categories far exceeds the number of vacancies (as many as 600 applicants for 30 vacancies), the academies are not concerned about being unable to fill the vacancies with highly qualified young men. That, plus the fact that it is administratively desirable to spread the work of admissions out over as large a time span as is practical, has prompted the academies to require applicants for competitive vacancies to submit the required entrance examination scores as early as January. Prep schools having students with competitive nominations adjust their curriculums to provide them with the maximum preparation for the earlier administrations of the CEEB tests.

Because a considerable number of students from the prep schools enter the academies via the competitive categories, the second part of this report, namely the relationship of final CEEB test scores to college performance, utilizes either the January or the March scores, whichever are available. Further, the higher of the two scores (if both are available) on any one test is used. This is common practice in all the academies, and is applied to all applicants.

Since many students in the prep schools took the CEEB tests more than once, a preliminary test of the effect of multiple-test taking was necessary to determine whether the March test results for such students could be safely combined with those of students who took only the March exams. Analyses of variance and covariance (controlled for differences in September scores) were carried out on samples selected from those prep schools in which a sufficient variety of test-taking combinations were available.

It was anticipated that there would be significant differences among the prep schools with respect to their average CEEB test scores from the March administration for the determination of which, analyses of variance were

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[3]From 12 to 19 percent of each entering class in the service academies is composed of young men who do not have Congressional appointments. The competitive categories have been established by Congress to assist sons of military fathers, of deceased veterans and young men in the military service to enter the academy.

carried out on both the September and March scores. Analyses of covariance were also carried out in which March scores were adjusted for differences in input as measured by the September scores.

In addition, a certain amount of background data was obtained from available records. They included:

a. Number of secondary schools attended.
b. Number of mathematics courses taken prior to entering the prep school.
c. Number of English courses taken prior to entering the prep school.
d. The most recent test score of intellectual development and/or aptitude.
e. Secondary school standing.

Since all the background data was not available on all students who took the CEEB tests in March and hence would have necessitated a considerable reduction in the sizes of samples in the various prep schools, the relative effect of the background variables on average March scores was evaluated by computing a multiple within-groups correlation; i.e., by determining whether valid March test score within-groups variance was predictable over and above that which was predictable from the September test score within-groups variance.[4]

Lists of text books and course schedules were also obtained for each prep school in the event that (a) differences in CEEB test score increases were sufficiently consistent across tests of similar content among the prep schools; e.g., SAT-M, Intermediate Mathematics, and Advanced Mathematics, and (b) the number of groups of prep schools showing like increases in test scores as a result of analyses of variance and covariance were small -- no more than three and preferably two. If both of the above conditions were to occur, a careful examination of texts and schedules might well reveal differences in such patterns consistent with the differences in score increases.

Because over half of the prep schools had indicated that it was their policy to devote a few days to the administration and simultaneous study of dummy examinations just prior to the March exams, it had been planned to carry out a second experimental administration of the entire test battery just prior to the beginning of the "pure" practice period. As it turned out, only one of the schools devoted a sufficient amount of time to practice to make a second administration of the test battery worthwhile. This second administration was of no consequence to the main purpose of the study since

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[4]See McNemar, Quinn, Psychological Statistics, second edition, p. 354.

the practice period must be considered as part of the curriculum of the school. On the other hand, it was of special interest to the prep schools to know whether time devoted to the practice was of any assistance to the student.

Hence a second administration of the test battery was carried out at Columbian, two weeks prior to the National March Administration (March 3). The results of the study are reported in Appendix B as a matter of academic interest.

The second phase of the study deals with the actual performance of students attending Service academies during their first year in college as measured by their end-of-year performance with respect to the degree to which their end-of-year performance is consistent with expected performance had their final College Board scores been as valid predictors as they are for their college classes as a whole. The expected performance distribution in fifths was computed from the known correlation between the College Board tests and final class standing, and the Chi square test of goodness of fit carried out between the expected and the actual class standing in fifths. By adopting a relatively low correlation coefficient and by determining expected standings separately for each academy, the separate service academies samples could be combined into a single sample.

Subsequent to the general study of the relationship between expected college performance and actual college performance, for which the entire sample was used, the same analyses were carried out for the students from the separate prep schools as far as it was practicable (provided there were a sufficient number from a given prep school that attended a service academy).

Coincident with the study of performance of prep school students at the service academies was the determination of whether the prep school students attending the academies were representative of the entire prep school sample with respect to the average increase in scores from September to March. Since previous studies carried out at the separate academies had utilized only those in attendance at the academies, there was some question as to whether the academy samples were representative or typical of the prep school graduates average increase in CEEB test scores.

The questions and the order in which they are treated in this report are:

A. The Effect of Special Prep School Curriculums on CEEB Test Scores; and

B. Relationship Between CEEB Test Scores and End-of-Freshman-Year College Performance.

1. In the Service Academies

2. Civilian Colleges

Analysis of the Data

A. The Effect of Special Prep School Curriculums on CEEB Test Scores

A preliminary examination of the effect of multiple test taking on final scores was carried out (Appendix A) to determine whether students taking the tests in December and/or January as well as in March could be combined with those who took only the March examinations. There was no evidence to indicate that they could not be combined.

Before evaluating the overall change in scores as a result of exposure to coaching school curriculums, it was first necessary to determine whether there were any differences in score changes attributable to differences in the school curriculums. Analyses of variance and co-variance (controlled for differences in input) were carried out on all five tests using the March scores as the criterion.

Significant differences were found among the schools with respect to both input as measured by both initial (September) scores and final (March) scores. Analyses of covariance were then carried out in which March scores were adjusted for differences in initial (September) scores. Although the F-values were reduced when final scores were controlled for differences in input, significant differences remained.[5]

The results of the analyses are summarized below.

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[5]Multiple within-group correlations were also computed using all students for whom complete data was available; i.e., for whom we not only had September and March scores but also (a) number of secondary schools attended; (b) number of prior mathematics courses; (c) number of prior English courses; (d) test scores of intellectual development; and (e) secondary school standing. The maximum number of students was 448. Because of the considerable reduction in the N (from 715 to 448), the application of the results would have been extremely limiting for the entire study had the multiple within-group correlation been significantly increased by the addition of one or more background variables. As it turned out, the within-group correlation between September and March SAT-V scores was raised from .809 to .810 by the addition of secondary school standing; from .826 to .827 for SAT-M; from .650 to .660 for English Composition; and from .740 to .750 for Intermediate Mathematics. The results do not justify the introduction of additional controls with the hope of further reducing obtained differences among the schools. For additional details, see Appendix C.

Table 2

SUMMARY OF F-VALUES OBTAINED FROM ANALYSES OF VARIANCE AND COVARIANCE OF CEEB TEST SCORES FROM TEN PREP SCHOOLS

	SAT-V[1]		SAT-M[1]	
	September	March	September	March
Analyses of Variance	15.40	10.41	27.92	25.19
Analyses of Covariance		5.624		3.361

	English Composition[2]		Int. Math[2]		Adv. Math[3]	
	Sept.	March	Sept.	March	Sept.	March
Analyses of Variance	16.116	19.289	19.21	19.44	5.819	13.688
Analyses of Covariance		9.259		6.904		7.972

[1] F-values of 1.90 significant at .05 level, and 2.46 significant at .01 level.

[2] F-values of 1.96 significant at .05 level, and 2.55 significant at .01 level.

[3] F-values of 2.05 significant at .05 level, and 2.73 significant at .01 level.

Adjusted March means (3) were then computed[6] and Tukey's[7] (2) procedure for comparing individual means was applied. The results of the application of Tukey's procedure are presented in Table 3.

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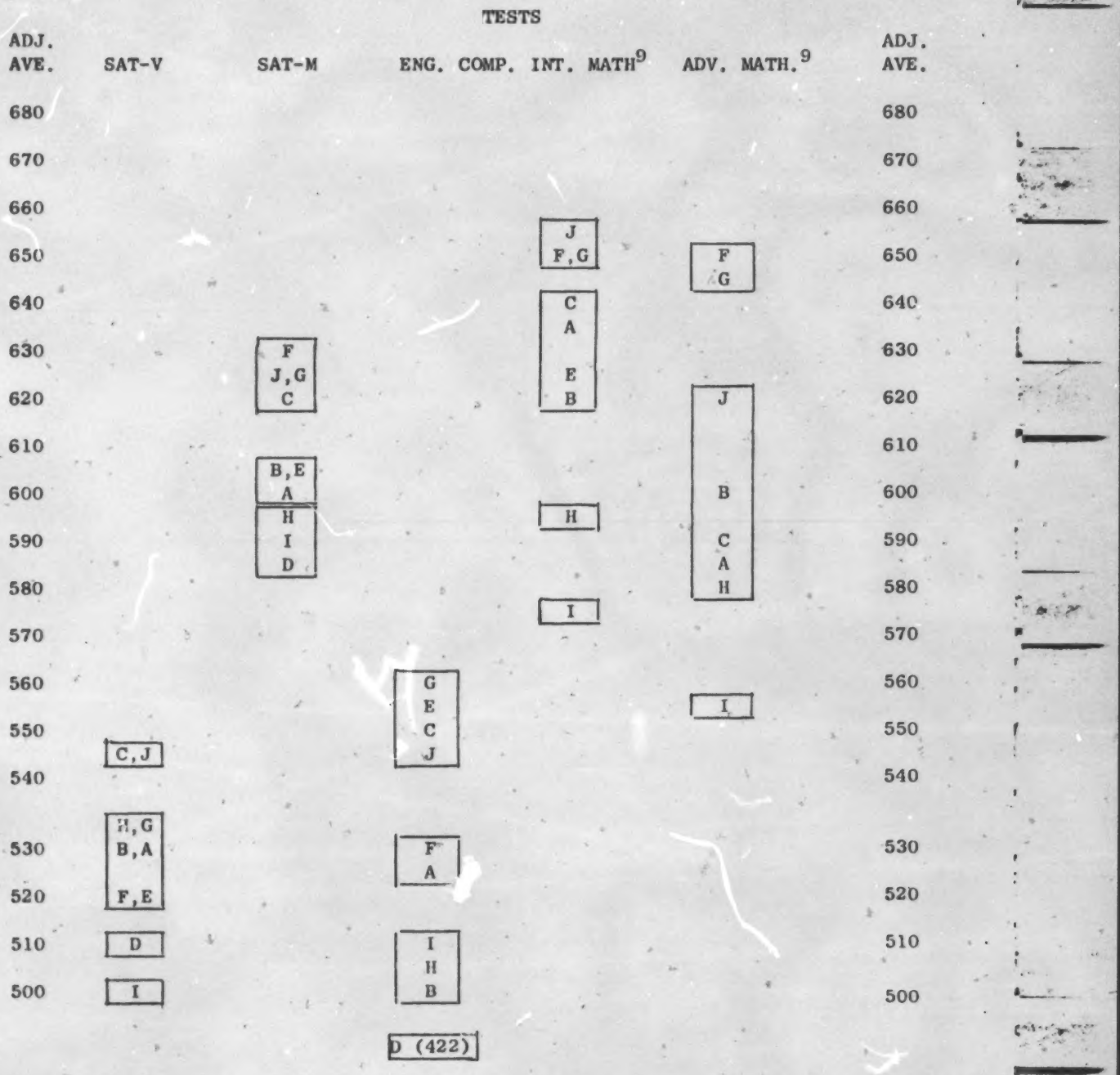
[6] The formula for computing adjusted March scores is $M_x - b_x (M_x - \bar{M}_x)$ where b_x = the within-group correlation.

[7] It should be noted that the procedure outlined calls for equal N's in each of the subgroups. Lacking equal N's, the average N was used as the best available approximation.

Table 3

AVERAGE COLLEGE BOARD TEST SCORES (MARCH 1963) ADJUSTED FOR DIFFERENCES IN INPUT (SEPTEMBER SCORES) FOR STUDENTS FROM TEN PREP SCHOOLS[8]



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[8]Blocks of schools are significantly different from one another. There are no significant differences among schools within blocks.

[9]Not enough cases in school D to include in analysis.

The September and March average scores, together with average score increases, are presented in Tables 4 through 8 for groups as defined in Table 3.

Table 4

SUMMARY OF DIFFERENCES BETWEEN SEPTEMBER AND MARCH SCORES ON SAT-VERBAL BY GROUPS

	September		March		Difference
	M	SD	M	SD	(M-S)
Group 1 (C,J) (N=83)	450	91	527	92	+77
Group 2 (A,B,E, F,G,H) (N=600)	475	88	531	84	+56
Group 3 (D) (N=5)	456	64	504	106	+47
Group 4 (I) (N=26)	437	78	472	72	+35

Table 5

SUMMARY OF DIFFERENCES BETWEEN SEPTEMBER AND MARCH SCORES ON SAT-MATHEMATICAL BY GROUPS

	September		March		Difference
	M	SD	M	SD	(M-S)
Group 1 (C,F,G,J) (N=232)	570	98	653	86	+83
Group 2 (A,B,E) (N=405)	520	93	598	85	+78
Group 3 (D,H,I) (N=78)	479	96	551	103	+72

Table 6

SUMMARY OF DIFFERENCES BETWEEN SEPTEMBER AND MARCH SCORES ON ENGLISH COMPOSITION BY GROUPS

	September		March		Difference
	M	SD	M	SD	(M-S)
Group 1 (C,E,G,J) (N=367)	472	81	568	86	+95
Group 2 (A,F) (N=154)	439	84	518	90	+78
Group 3 (B,H,I) (N=126)	438	73	490	85	+52
Group 4 (D) (N=2)	386	--	372	--	---

Table 7

SUMMARY OF DIFFERENCES BETWEEN SEPTEMBER AND MARCH SCORES ON INTERMEDIATE MATHEMATICS BY GROUPS

	September		March		Difference
	M	SD	M	SD	(M-S)
Group 1 (F,G,J) (N=187)	537	81	686	78	+149
Group 2 (A,B,C,E) (N=361)	484	84	615	89	+131
Group 3 (H) (N=37)	441	78	554	112	+112
Group 4 (I) (N=25)	453	105	537	140	+ 83

Table 8

SUMMARY OF DIFFERENCES BETWEEN SEPTEMBER AND MARCH SCORES ON ADVANCED MATHEMATICS BY GROUPS

	September		March		Difference
	M	SD	M	SD	(M-S)
Group 1 (G,F) (N=127)	522	83	666	67	+144
Group 2 (A,B,C,H,J) (N=102)	467	77	584	97	+117
Group 3 (I) (N=22)	448	103	525	94	+ 77

Observation alone is sufficient to deduce that all increases in scores from September to March are significant, particularly when one considers that the correlations between September and March scores are as follows:[10]

SAT-V	-	.81
SAT-M	-	.83
EC	-	.69
IM	-	.76
AM	-	.74

B. Relationship Between College Board Scores and End-of-Freshman-Year College Performance

1. Prep School Students Attending Service Academies

Of the total original sample (1206), 405 entered service academies in September, 1963, 18 of whom were separated for academic reasons and 62 of whom resigned by the end of the first academic year. The summaries by Service Academies are as follows:

[10] When testing for the significant difference between correlated means, the standard error of the differences (by which the Mean difference is decided) is reduced as the correlation is increased:

$$SE_{diff(corr.\ means)} = \sqrt{\sigma_1^2 + \sigma_2^2 - 2r\sigma_1\sigma_2}$$

$$SE_{diff(uncorr.\ means)} = \sqrt{\sigma_1^2 + \sigma_2^2}$$

	Entered	Active at End of First Year	Academically Deficient	Resigned
USAFA	133	114	4	15
USCGA	1	0	0	1
USMA	72	58	1	13
USMMA	22	19	0	3
USNA	177	134	13	30
Totals	405	325	18	62

One of the questions not answered by previous in-house studies at both the Air Force and Military Academies was whether their prep school samples were truly representative of the prep school population with respect to the average increase in scores. It is apparent from Table 9 that considerable selectivity was exercised by the academies in their admissions policies.

Table 9

SEPTEMBER AND MARCH COLLEGE BOARD SCORES OF THOSE WHO ENTERED A SERVICE ACADEMY VS. ORIGINAL SAMPLE

	Service Academies					Total Sample				
	N	September		March		N	September		March	
		M	SD	M	SD		M	SD	M	SD
SAT-V	314	517	68	573	65	714	471	89	528	85
SAT-M	314	580	80	657	61	715	532	99	611	94
EC	309	494	68	589	70	649	458	82	540	93
IM	288	536	75	676	71	610	497	89	629	100
AM	141	526	.79	658	75	251	494	85	620	96

Whether these policies favored the individuals whose scores were boosted higher than the average increment was determined by computing difference scores for two groups; those who entered the academy and those who did not. The average increments for the two groups are presented in Table 10.

Table 10

SUMMARY OF INCREMENTS FROM SEPTEMBER TO MARCH SCORES FOR THOSE WHO ENTERED SERVICE ACADEMIES AND THOSE WHO DID NOT

	Cadets			Non-Cadets			
	N	M	SD	N	M	SD	t-values
SAT-V	314	56.86	--[1]	400	58.39	--[1]	
SAT-M	314	76.60	--[1]	401	80.74	--[1]	
EC	309	95.19	61.87	340	70.99	54.74	5.26**
IM	288	139.85	61.79	322	126.42	68.44	2.53*
AM	141	131.14	61.14	110	121.37	69.50	(NS)

*Significant at the .05 level.
**Significant at the .01 level.
[1]Was not computed.

The increments on both English Composition and Intermediate Mathematics were significantly higher for cadets than non-cadets. It should be noted, however, that it is customary for the academies to use the highest score obtained on a given test when assessing the qualifications for all applicants. In addition, since either the Intermediate or Advanced Mathematics score may be submitted, the higher of the two is used in computing the average Math Achievement test score. Hence, for the purpose of this phase of the study, the relative positions of "prep school" cadets are not out of line with the relative positions of "non-prep school" cadets.

The average College Board scores for the classes entering in 1963 were quite different for the various academies (Table 11).

Table 11

AVERAGE COLLEGE BOARD SCORES OF CLASSES ENTERING THE SERVICE ACADEMIES IN JULY, 1963

	SAT-V	SAT-M	EC	I or AM
USAFA	599	678	590	660
USCGA[1]	---	---	---	---
USMA	568	644	556	627
USMMA[2]	549	615	521	591
USNA[2]	591	663	583	645

[1]USCGA did not use the CEEB examinations as an entrance requirement.

[2]Manual of Freshman Class Profiles, 1964 Edition, College Entrance Examination Board, 1964

Because of the variations in mean scores for the separate academies, it was necessary to convert the scores to a common standard. Although it would have been desirable to use a standard score conversion, the standard deviations for three of the academies were not available. An adequate conversion was effected by determining the fifth of each score distribution in which individual scores were located. The distributions by fifths on each test were approximated from the 50-point distributions reported in the Manual of Freshman College Profiles, 1964 Edition (Table I in Appendix D). The obtained distributions are presented in Table 12. (See Table II in Appendix D for separate service academy distributions.)

Table 12

COLLEGE BOARD EXAMINATION DISTRIBUTIONS OF PREP SCHOOL STUDENTS WITHIN SERVICE ACADEMY DISTRIBUTIONS

Distribution	Entrance Examinations			
	SAT-V	SAT-M	EC	I or AM
Top fifth	51	67	95	138
2nd fifth	54	61	74	72
3rd fifth	66	65	73	57
4th fifth	83	65	45	31
5th fifth	62	58	28	17
Totals[1]	316	316	315	315

[1]The highest score for any of three possible National CEEB administrations (December, January, or March) was selected for the distributions. The equal N's (one cadet was not required to take the achievement test) are due to obtaining scores from either the January or March CEEB administrations.

From the above distributions, the expected distributions were computed using the probability tables developed by Richard P.T. Scott.[11] The predicted distributions were developed using the table for an r of .35 between the independent and dependent variable (End-of-Freshman-Year Class Standing) even though the actual correlations between the converted class standing[12] and the five College Board scores were all above .40 (Table 13). (See Appendix E for a further description of the procedures followed.)

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[11]See Statistical Procedures and Their Mathematical Bases, Peters and Van Voorhis, McGraw-Hill Book Co., 1940, pp. 508-510.

[12]The formula used for converting class standing in the separate academies was:

$$800 - \left\{ \left\{ \frac{(2\ (\text{actual standing}) - 1)}{(2\ (\text{class size}))} \right\} \times 800 \right\}$$

Table 13

CORRELATIONS BETWEEN END OF FRESHMAN YEAR CLASS STANDING AT THE SERVICE ACADEMIES AND THE COLLEGE BOARD TESTS SCORES OBTAINED AT THE JANUARY AND MARCH ADMINISTRATIONS

	MARCH		JANUARY	
	N	r	N	r
SAT-V	242	.431	224	.420
SAT-M	242	.424	224	.436
EC	240	.382	228	.430
IM	223	.443	228	.418
AM	121	.438	138	.468

The predicted (expected) distributions together with the actual distributions are presented in Table 14.

Table 14

PREDICTED (E) AND OBTAINED (O) DISTRIBUTIONS OF FRESHMAN CLASS STANDING FOR PREP SCHOOL STUDENTS ATTENDING THE SERVICE ACADEMIES

Fifths	SAT-V		SAT-M		EC		I or AM	
	E	O	E	O	E	O	E	O
Top	59	37	64	37	73	37	81	37
2nd	63	44	64	44	67	44	70	44
3rd	64	85	63	85	64	85	63	85
4th	65	58	63	58	59	57	56	57
Bottom	65	92	62	92	52	92	45	92
Chi^2 =	32.79		40.24		63.38		90.346	

From the summaries in Table 14, it is apparent that the actual performance of prep school students attending the Service Academies was significantly poorer than what was predicted, and that such was the case more so with predictions from the achievement tests than from the aptitude tests.

One question remains to be answered; i.e., are there significant differences among the Prep Schools with respect to predicted vs. actual performance at the Service Academies? The schools for which there was a sufficient number of cases to provide some answer to the question are B, A, J, G, F, and E. The predicted and obtained distributions by prep schools are presented in Table III in Appendix D. The hypothesis that the college performance was consistent with the performance predicted from the College Board tests was accepted if the differences between the two could have occurred by choice in less than 99 out of 100 times. The Chi Square test was used, the value required for rejection of the hypothesis being 13.277.

The performance of cadets from schools B, G, F, was consistent with their predicted performance for all four tests.

School J's performance was significantly lower than that which was predicted from scores on the Intermediate or Advanced Mathematics Test.

The performance of cadets from schools A and E was significantly lower than predicted performance for all four College Board tests.

2. Prep School Students Attending Civilian Colleges

Of the 412 who had not gone to a service academy, cards were sent to 349 on whom addresses were available, asking the student whether he entered college in September and, if so, what college. Two hundred twenty-eight (228) responded of whom 165 indicated they had entered a college in September, 1963. A cover letter explaining the project was sent to the registrars of the 117 colleges attended, together with a form in which they were asked to indicate the approximate class standing of the student in (a) his math or physical science course and (b) his English course. Adequate data was obtained on 130 students.

It is worthy of note that the civilian college sample is considerably less capable than the service academy sample on the basis of average College Board scores (Table 15).

Table 15

SUMMARY OF MARCH COLLEGE BOARD SCORES OF PREP SCHOOL STUDENTS ENTERING CIVILIAN COLLEGES AND SERVICE ACADEMIES

	Service Academies			Civilian Academies		
	N	M	SD	N	M	SD
SAT-V	242	575.67	60.69	123	497.57	81.85
SAT-M	242	663.14	59.36	123	567.22	96.53
EC	240	590.07	70.03	105	487.50	90.72
IM	223	688.67	56.01	94	570.74	109.55
AM	121	659.40	76.44	30	550.60	106.45

Assuming some degree of comparability between the service academies and the civilian colleges represented, it would be expected that the latter's college performance would be relatively poorer than that of the former. The performance of the civilian college sample in the major math or science course and English course is presented in Table 16.

Table 16

DISTRIBUTION BY FIFTHS OF PREP SCHOOL STUDENTS IN CIVILIAN COLLEGE FRESHMEN MATH OR SCIENCE COURSE AND IN ENGLISH COURSES

Class Fifths	Math or Physical Science	English
Top	12	4
2nd	12	13
3rd	27	41
4th	18	23
Bottom	26	31
Failed	28	18

Some effort was made to determine whether the performance in civilian colleges was consistent with what was to be expected on the basis of the March College Board test scores. However, since only 34 of 117 colleges reported frequency distributions on SAT-V and SAT-M in the Manual of College Board Profiles, it was impossible to determine the relative standing on the tests for each student. Nevertheless, the average scores of the 34 on which distributions were available were computed. For 22,508 subjects on SAT-V, the mean score was 521.80 and the standard deviation was 99.30. From the summary statistics presented in Table 15, one would expect the prep school group to perform somewhat less than average in English and about average in mathematics. The distributions of performance in math or physical science courses and in English for the civilian college sample does not seem to be inconsistent (Table 16).

Discussion of Results

From the foregoing analyses, the following results are noteworthy:

a. Both SAT-Verbal and Mathematical test scores increased significantly beyond what has been considered typical for a senior year in secondary school. The College Entrance Examination Board (1) reports an average increase of 40 points (Male students) in SAT-Verbal and 43 points in SAT-Mathematical scores from preliminary to final testing (March, 1963 through January, 1964). Both Groups 1 and 2 (Table 4) show significantly larger increases in SAT-V and all groups (Table 5) show significantly larger increases in SAT-M.

b. There are no normative data available for senior year gains on the achievement tests. One can only surmise from the distribution of achievement test scores for entrants from prep schools (Table 12) that the average increases in scores on the achievement tests are atypical.

c. There are significant differences among the schools with respect to the degree to which scores are increased even when adjusted for differences in initial scores. Those schools for which the greatest increase in scores was obtained, also had superior input as measured by the September scores. Since these differences among schools remained even after they were controlled for differences in input, it is apparent that there are differences in curriculums. It is logical to assume that schools accepting only the better equipped student are able to go into subject matter at greater depth and at greater lengths than those that accept the less equipped student.

d. As a group, cadets from prep schools performed significantly poorer than was predicted. The adopted correlation of .35 between College Board scores and subsequent college performance was conservative in the light of the actual correlations of .40 to .48.

Analyses of performance of cadets from separate prep schools was carried out but with more stringent requirements for rejection of the hypothesis than were adopted for the analysis of the performance of the group as a whole. In

other words, we were willing to err in favor of the hypothesis that there was no significant difference between predicted and actual performance. Consequently, the fact that no significant differences were found between predicted and actual performance for certain Prep Schools does not preclude the possibility of there actually being a real difference. On the other hand, the degree of confidence that can be placed in the results which showed a significant difference between predicted and actual performance is considerably greater.

There were no significant differences between actual performance and performance predicted from any of the College Board test scores for cadets from three prep schools, B, G, and F. All other schools showed actual performance to be significantly lower than performance predicted from the Intermediate or Advanced Mathematics tests. Finally, two schools, A and E, showed actual performance significantly below performance predicted from scores on all College Board tests.

As was expected, achievement test scores were raised far more than the aptitude test scores, and the math achievement scores more so than the English achievement scores. Achievement tests are by nature content-oriented, hence, the more intensive the coverage of English facts, literature, and mathematical areas, the more likely will scores be raised. Nevertheless, the achievement tests are important tests for college selection. The results of this study would seem to indicate the scores on achievement tests for applicants who have attended a prep school offering a one-year curriculum ought to be played down, or at least adjustments made for scores obtained. Such adjustments can be easily determined by statistical procedures and should be done separately for each institution.

That students from two prep schools should perform significantly below what was predicted from the SAT test scores does not necessarily mean that the schools in question have found the answer to boosting said scores significantly above the ability of the student because most of the students from the two schools in question entered the same institution. An institutional study should be made with special attention being given to the type of student accepted from the two schools. It is possible that a large majority of the students in question may participate in a very active extracurricular program in their Freshman year. If such were the case, it is understandable that their performance would be somewhat lower than the predicted performance.

Observations

The results of the study lead to the following observations:

a. Those prep schools offering one-year curriculums for boys seeking admission to college would assist the student most (i.e., final College Board scores would be more consistent with the student's actual performance) if they would gear their curriculums to the Freshman college level.

b. Those schools that accept anyone who wishes to enter, do the boy a disservice if they only succeed in raising College Board scores to a level acceptable by the college of the applicant's choice.

c. Schools that accept any students who wish to come, do the boy a real service if they concentrate on content without any special attention being given to tests and test items. A young man who is seeking assistance of the sort offered by prep schools with one-year curriculums would do well if he examined them as he examines four-year colleges; i.e., for strength of their curriculums; not on the basis of how many of the school's graduates get into college, but how well they do after they are in college.

Finally, prep schools which terminate the course of study with the administration of CEEB tests in January or March can hardly compete with those requiring the student to stay on until the end of May if the student is to obtain a favorable recommendation from the prep school. The adoption of such a policy by all prep schools would have a beneficial effect. Not only would the student be better prepared, but it would also follow that students coming from the prep schools would receive considerably more favorable consideration by the four-year colleges to which they apply.

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APPENDIX A

THE EFFECT OF REPEATED TEST TAKING ON FINAL CEEB TEST SCORES

APPENDIX A

The Effect of Repeated Test Taking on Final Scores:

Students from the various schools could and did take the College Board tests at regular administrations more than once between the experimental administration in September and the criterion administration in March. Some took the tests in December and/or January as well as in March. Before they could be combined with those who took only the March exams, it was necessary to determine whether there were any significant differences in March scores for the various groups.

Because preliminary examinations showed marked differences among schools in the average September College Board scores, it was necessary to select schools whose students differed sufficiently in their test taking to permit analysis within schools. Three such schools were identified: the USNAPS on all but Advanced Math; Sullivan on SAT-V and SAT-Math, and Bullis on English Composition and Intermediate Mathematics. Summary statistics for the three schools are presented in Table 1.

The results of the analyses of variance on students at USNA and Bullis showed no significant differences among groups. Significant differences in March SAT-M scores were found for Sullivan, which were eliminated when adjusted for differences in September scores (analysis of covariance). A significant difference was also found in the September SAT-V scores for the Sullivan students, but no differences in March scores; nor were any significant differences found in March SAT-V scores when adjusted for differences in September scores.

Table 1

MEANS AND STANDARD DEVIATIONS OF COLLEGE BOARD SCORES OF STUDENTS TAKING THE EXAMINATIONS IN VARIOUS COMBINATIONS OF NATIONAL ADMINISTRATIONS

SAT-VERBAL

Test-taking Combinations	USNA N	USNA September Scores M	USNA September Scores SD	USNA March Scores M	USNA March Scores SD	SULLIVAN N	SULLIVAN September Scores M	SULLIVAN September Scores SD	SULLIVAN March Scores M	SULLIVAN March Scores SD
Sep-Mar	105	500	88	542	82	19	452	76	539	89
Sep-Dec-Mar	16	478	68	511	53	15	373	77	436	85
Sep-Jan-Mar	40	471	74	524	68	0	---	--	---	--
Sep-Dec-Jan-Mar	12	464	75	510	68	8	467	84	533	69

SAT-MATHEMATICAL

	USNA					SULLIVAN				
Sep-Mar	105	558	68	629	64	19	485	82	568	79
Sep-Dec-Mar	16	525	82	591	91	15	462	88	509	96
Sep-Jan-Mar	40	575	77	641	66	0	---	--	---	--
Sep-Dec-Jan-Mar	12	521	60	610	61	8	532	93	641	105

ENGLISH COMPOSITION

	USNA					SULLIVAN				
Sep-Mar	110	468	72	564	77	9	476	78	540	88
Sep-Dec-Mar	0	---	--	---	--	0	---	--	---	--
Sep-Jan-Mar	52	458	72	566	77	35	465	57	498	79
Sep-Dec-Jan-Mar	8	479	58	573	38	16	460	77	507	85

Table 1 (Continued)

INTERMEDIATE MATHEMATICS

	USNA					SULLIVAN				
		September Scores		March Scores			September Scores		March Scores	
	N	M	SD	M	SD	N	M	SD	M	SD
Sep-Mar	110	505	73	630	74	10	459	59	579	50
Sep-Dec-Mar	0	---	--	---	--	0	---	--	---	--
Sep-Jan-Mar	52	507	77	632	77	30	503	64	623	64
Sep-Dec-Jan-Mar	8	567	84	659	75	9	491	86	624	72

APPENDIX B

THE EFFECT OF PRACTICE ON COLLEGE BOARD SCORES

APPENDIX B

The Effect of Practice on College Board Scores

Although initial correspondence with the schools participating in the study had indicated that several had a period just prior to the March exams which was reserved for "dry runs" of tests comparable to the CEEBs, it developed that only one school devoted a period of time of sufficient length to warrant special testing to determine the effect of practice. At Columbian the last ten days were devoted to test taking. During that period, tests comparable to the SAT tests, the English Composition, and Intermediate Mathematics were administered and studied. This process was carried out twice, each test administration being followed by a review of the test.

On the day preceding the practice period, the entire experimental battery was readministered (February 15, 1963). Motivation was maintained at a high level by having the Proctors (Columbian instructors) indicate to the students that the administration was consistent with the program at Columbian, plus the fact that the tests being administered were actually operational at that time. The results of the study of the effect of practice are summarized below.

Table 1

PRE- AND POST-PRACTICE SCORES ON FIVE COLLEGE BOARD TESTS

	Pre-Test (February)			Post-Test (March)		Pre-Post	
	N	M	SD	M	SD	r Feb-Mar	T Value[1]
SAT-V	142	493	94	502	83	.7993	1.870*
SAT-M	142	560	106	556	93	.9022	NS
E.C.	116	505	86	513	88	.6927	1.182 (NS)
I.M.	112	574	108	598	100	.8466	4.336**
A.M.	15	561	106	560	101	.8936	NS

[1]One-tailed test for correlated means.
*Significant at the .05 level.
**Significant at the .01 level.

The results of the study indicate that practice alone did affect certain test scores, the Intermediate Mathematics in particular. The fact that not all five showed significant increases in scores attests to the adequacy of the level of motivation at the pre-practice session.

APPENDIX C

RELATIONSHIP BETWEEN OTHER BACKGROUND VARIABLES AND CEEB TEST SCORES

APPENDIX C

Relationship Between Other Background Variables and CEEB Test Scores

Additional information which had been obtained at the time of the initial administration of the College Board tests was examined to determine whether March score differences could be further reduced. These included:

a. Number of secondary schools attended;

b. Number of math courses taken;

c. Number of English courses taken;

d. The High School Rank Score[1]; and

e. An Intelligence Index[2].

Correlations between the selected background variables and the College Board tests are presented in Table I. The Intelligence Index, HSR, and Number of Math courses were the most promising but once the March scores were controlled for differences in September scores, the background variables made no significant contribution. The means and standard deviations of the background variables for each of the groups as defined in Table 3 are presented below (Tables II through VI).

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[1]The High School Rank was converted to a normalized distribution with a mean of 50 and a standard deviation of 10.

[2]The Intelligence Index is a stanine conversion of a variety of tests used in secondary schools as indexes of intellectual development and/or aptitude. The conversion tables are presented in Table VII.

Table I

CORRELATIONS BETWEEN SELECTED BACKGROUND VARIABLES AND SEPTEMBER AND MARCH CEEB SCORES

SEPTEMBER

CEEB Tests	Intelligence Index r (N)	No. of Secondary Schools r (N)	No. of Math Courses r (N)	No. of English Courses r (N)	HSR r (N)
SAT-V	.366 (878)	.030 (1064)	.178 (1063)	.014 (1062)	.394 (812)
SAT-M	.313 (880)	.024 (1066)	.329 (1065)	.032 (1064)	.471 (814)
EC	.314 (879)	.007 (1064)	.181 (1063)	.015 (1062)	.435 (811)
IM	.278 (878)	.004 (1062)	.390 (1061)	.050 (1060)	.499 (810)
AM	.281 (700)	.038 (873)	.419 (873)	.110 (873)	.543 (659)

MARCH

SAT-V	.239 (568)	.013 (694)	.177 (693)	.004 (692)	.372 (546)
SAT-M	.293 (568)	.045 (694)	.303 (693)	.003 (692)	.458 (546)
EC	.290 (511)	.060 (630)	.149 (629)	.015 (628)	.436 (495)
IM	.268 (487)	.030 (591)	.280 (590)	.017 (589)	.452 (467)
AM	.320 (163)	.173 (245)	.256 (245)	.162 (245)	.602 (198)

Table II

MEANS AND STANDARD DEVIATIONS OF SELECTED BACKGROUND VARIABLES FOR GROUPS IDENTIFIED AS SIGNIFICANTLY DIFFERENT ON SAT-V INCREMENT SCORES

School Groups	Background Variables: Intelligence Index M	SD	No. SS Attended M	SD	No. of Math Courses M	SD	No. of Eng. Courses M	SD	HSR Score M	SD
C,J	6.40	2.04	1.58	.72	3.90	.84	4.04	.41	49.35	8.73
	(N=52)		(N=93)		(N=93)		(N=93)		(N=63)	
A,B,E, F,G,H	6.84	2.09	1.41	.53	3.96	1.01	3.98	.46	51.17	9.42
	(N=797)		(N=915)		(N=914)		(N=913)		(N=718)	
D	6.42	1.84	2.23	.93	3.08	.78	3.46	.69	50.50	3.84
	(N=7)		(N=26)		(N=26)		(N=26)		(N= 4)	
I	5.82	1.72	1.00	.00	3.53	.84	3.90	.40	50.67	7.97
	(N=22)		(N=30)		(N=30)		(N=30)		(N=27)	

Table III

MEANS AND STANDARD DEVIATIONS OF SELECTED BACKGROUND VARIABLES FOR GROUPS IDENTIFIED AS SIGNIFICANTLY DIFFERENT ON SAT-M INCREMENT SCORES

School Groups	Background Variables: Intelligence Index M	SD	No. SS Attended M	SD	No. of Math Courses M	SD	No. of Eng. Courses M	SD	HSR Scores M	SD
C,F,G,J	7.61	1.90	1.43	.67	4.17	.94	4.07	.46	55.25	8.38
	(N=310)		(N=410)		(N=410)		(N=410)		(N=330)	
A,B,E	6.42	2.02	1.40	.67	3.76	1.00	3.91	.46	48.42	8.80
	(N=494)		(N=536)		(N=535)		(N=534)		(N=399)	
D,H,I	5.73	2.06	1.56	.75	3.75	1.00	3.89	.48	46.61	8.60
	(N= 74)		(N=118)		(N=118)		(N=118)		(N=183)	

Table IV

MEANS AND STANDARD DEVIATIONS OF SELECTED BACKGROUND VARIABLES FOR GROUPS IDENTIFIED AS SIGNIFICANTLY DIFFERENT ON ENGLISH COMPOSITION INCREMENT SCORES

School Groups	Background Variables: Intelligence Index M	SD	No. SS Attended M	SD	No. of Math Courses M	SD	No. of Eng. Courses M	SD	HSR Score M	SD
C,E,G,J	6.70	1.69	1.35	.63	4.16	.90	4.02	.37	54.57	8.23
	(N=319)		(N=420)		(N=419)		(N=418)		(N=331)	
A,F	7.54	1.62	1.43	.67	3.85	1.04	4.03	.47	48.72	9.39
	(N=393)		(N=403)		(N=403)		(N=403)		(N=333)	
B,H,I	5.12	2.72	1.50	.66	3.69	.97	3.81	.54	48.19	8.92
	(N=160)		(N=216)		(N=216)		(N=216)		(N=145)	
D	6.43	1.84	2.23	.93	3.08	.78	3.46	.69	50.50	3.84
	(N= 7)		(N= 26)		(N= 26)		(N= 26)		(N= 4)	

Table V

MEANS AND STANDARD DEVIATIONS OF SELECTED BACKGROUND VARIABLES FOR GROUPS IDENTIFIED AS SIGNIFICANTLY DIFFERENT ON INTERMEDIATE MATHEMATICS INCREMENT SCORES

School Groups	Background Variables: Intelligence Index M	SD	No. SS Attended M	SD	No. of Math Courses M	SD	No. of Eng. Courses M	SD	HSR Score M	SD
F,G,J	7.73	1.85	1.43	.67	4.19	.92	4.07	.47	56.02	7.90
	(N=289)		(N=381)		(N=380)		(N=381)		(N=307)	
A,B,C,E	6.41	2.02	1.40	.66	3.77	1.01	3.91	.46	48.23	8.79
	(N=515)		(N=565)		(N=564)		(N=563)		(N=422)	
H	5.58	2.21	1.55	.61	4.14	.96	4.06	.25	44.21	8.27
	(N= 22)		(N= 62)		(N= 62)		(N= 62)		(N= 52)	
I	5.82	1.72	1.00	.00	3.53	.84	3.90	.40	50.67	7.97
	(N= 22)		(N= 30)		(N= 30)		(N= 30)		(N= 27)	

Table VI

MEANS AND STANDARD DEVIATIONS FOR SELECTED BACKGROUND VARIABLES FOR GROUPS IDENTIFIED AS SIGNIFICANTLY DIFFERENT ON ADVANCED MATHEMATICS INCREMENT SCORES

School Groups	Background Variables: Intelligence Index M	SD	No. SS Attended M	SD	No. of Math Courses M	SD	No. of Eng. Courses M	SD	HSR Score M	SD
F, G	7.86 (N=256)	1.78	1.39 (N=315)	.66	4.25 (N=315)	.95	4.08 (N=315)	.48	56.64 (N=267)	7.66
A,B,C, H,J	6.23 (N=418)	2.32	1.46 (N=513)	.66	3.71 (N=513)	.99	3.96 (N=513)	.46	46.51 (N=372)	9.05
I	5.82 (N= 22)	1.72	1.00 (N= 30)	.00	3.53 (N= 30)	.84	3.90 (N= 30)	.40	50.67 (N= 27)	7.97

Table VII

CONVERSION TABLES USED FOR SELECTED INDEXES OF INTELLECTUAL ABILITY

Stanine	LORGE-THORNDIKE	OTIS	SCAT Total	PMA	ACE	T-M	OSPT	K-A
	Verbal IQ	Dev. IQ		IQ	Dev. IQ			IQ
9	125 ↑	122 ↑	301 ↑	120 ↑	136 ↑	129 ↑	103 ↑	126 ↑
8	118-124	116-121	296-300	112-119	126-135	120-128	90-102	119-125
7	111-117	110-115	290-295	104-111	116-125	113-119	77- 89	112-118
6	104-110	104-109	283-289	96-103	106-115	107-112	64- 76	105-111
5	97-103	97-103	277-282	88- 95	96-105	99-106	43- 63	98-104
4	90- 96	91- 96	271-276	80- 87	86- 95	91- 98	36- 42	91- 97
3	83- 89	85- 90	265-270	72- 79	76- 85	83- 90	29- 35	84- 90
2	77- 82	79- 84	259-264	64- 71	66- 75	73- 82	22- 28	77- 83
1	76 ↓	78 ↓	258 ↓	63 ↓	65 ↓	72 ↓	21 ↓	76 ↓

Table VII (Continued)

Stanine	HENMON-NELSON	CTMM	WAIS (W-B)	STEP Math (12th Grade)	NMSQT		AGCT	PINTNER
	Ratio IQ	Total IQ			Comp. Scaled Score	Selection Score		Dev. IQ
9	127 ↑	126 ↑	129 ↑	296 ↑	29 ↑	124 ↑	130 ↑	125 ↑
8	120-126	119-125	121-128	290-295	25-28	109-123	122-129	118-124
7	113-119	112-118	113-120	284-289	21-24	95-108	114-121	111-117
6	106-112	105-111	105-112	278-282	17-20	79- 93	106-113	105-110
5	99-105	98-104	96-104	272-277	13-16	64- 78	97-105	96-104
4	92- 98	91- 97	88- 95	266-271	10-12	49- 63	89- 96	86- 94
3	85- 91	84- 90	80- 87	260-265	7- 9	34- 48	81- 88	77- 85
2	78- 84	77- 83	72- 79	254-259	4- 6	19- 33	73- 80	69- 76
1	77 ↓	76 ↓	71 ↓	253 ↓	3 ↓	18 ↓	72 ↓	68 ↓

APPENDIX D

GENERAL TABLES

TABLE I TEST SCORE INTERVALS FOR EACH 20% OF THE ENTERING CLASS TO THE SERVICE ACADEMIES

TABLE II DISTRIBUTIONS BY FIFTHS ON ENTRANCE EXAMINATIONS FOR FOUR SERVICE ACADEMIES

TABLE III PREDICTED AND OBTAINED END-OF-FRESHMAN-YEAR CLASS STANDING OF STUDENTS FROM PREP SCHOOLS

Table I

TEST SCORE INTERVALS FOR EACH 20% OF THE ENTERING CLASS TO THE SERVICE ACADEMIES

Fifths	USAFA	USMA	USMMA	USNA
		SAT-V		
Top	662 & above	641 & above	617 & above	646 & above
2nd	621-661	596-640	557-616	606-645
3rd	580-620	546-595	526-556	571-605
4th	530-579	502-545	485-525	531-570
Bottom	to 529	to 501	to 484	to 530
		SAT-M		
Top	732 & above	695 & above	671 & above	711 & above
2nd	699-731	664-694	630-670	680-710
3rd	664-698	630-663	598-629	649-679
4th	623-663	585-629	567-597	613-648
Bottom	to 622	to 584	to 566	to 612

Table I (Continued)

Fifths	USAFA	USMA	USMMA	USNA
		ENGLISH COMPOSITION		
Top	657 & above	631 & above	580 & above	637 & above
2nd	614-656	574-630	545-579	598-636
3rd	571-613	531-573	498-544	568-597
4th	528-570	487-530	455-497	521-567
Bottom	to 527	to 486	to 454	to 520
		INTERMEDIATE OR ADVANCED MATHEMATICS		
Top	737 & above	698 & above	650 & above	709 & above
2nd	685-736	643-697	601-649	665-708
3rd	637-684	601-642	565-600	626-664
4th	580-636	559-600	525-564	586-625
Bottom	to 579	to 558	to 524	to 585

Table II

DISTRIBUTIONS BY FIFTHS ON ENTRANCE EXAMINATIONS FOR FOUR SERVICE ACADEMIES

	SAT-V				SAT-M			
Fifths	USAFA	USMA	USMMA	USNA	USAFA	USMA	USMMA	USNA
Top	21	16	3	11	27	20	2	18
2nd	19	11	4	20	26	10	3	22
3rd	28	14	3	21	28	12	3	22
4th	29	7	1	46	23	5	2	35
Bottom	15	8	6	33	8	9	7	34

	EC				I or AM			
Fifths	USAFA	USMA	USMMA	USNA	USAFA	USMA	USMMA	USNA
Top	35	23	9	28	58	33	9	38
2nd	32	10	1	31	33	11	2	26
3rd	30	12	2	29	16	9	3	29
4th	6	9	3	27	5	2	1	23
Bottom	9	2	2	15	0	1	2	14

Table III

PREDICTED AND OBTAINED END-OF-FRESHMEN-YEAR CLASS STANDING OF STUDENTS FROM PREP SCHOOLS

School	B		A		J		G		F		E		C, H, I	
	E*	O*	E	O	E	O	E	O	E	O	E	O	E	O
I - SAT-V														
Fifths														
Top	4	2	7	2	5	1	18	21	11	8	13	3	3	0
2nd	4	2	8	2	4	2	19	22	10	10	14	5	3	1
3rd	5	5	8	12	4	3	19	22	10	15	15	23	3	5
4th	5	4	8	8	4	8	19	13	10	8	16	14	3	3
Bottom	4	9	9	16	3	6	17	14	10	10	17	30	4	7
Chi Square Values[1]	6.20		15.51		11.45		3.36		3.22		27.93		6.91	
II - SAT-M														
Top	4	2	8	2	3	1	21	21	12	8	13	3	2	0
2nd	4	2	8	2	4	2	20	22	11	10	14	5	3	1
3rd	4	5	8	12	4	3	19	22	10	15	15	23	3	5
4th	5	4	8	8	4	8	17	13	9	8	16	14	4	3
Bottom	5	9	8	16	5	6	15	14	9	10	17	30	4	7
Chi Square Values	5.65		21.00		6.78		1.67		4.14		27.93		7.16	

Table III (Continued)

III - EC

School	B		A		J		G		F		E		C, H, I	
	E*	O*	E	O	E	O	E	O	E	O	E	O	E	O
Fifths														
Top	4	2	8	2	5	1	23	21	13	8	16	3	3	0
2nd	4	2	8	2	4	2	21	22	12	10	17	5	3	1
3rd	4	5	8	12	4	3	18	22	10	15	15	23	4	5
4th	5	4	8	7	4	8	17	13	9	8	14	14	3	3
Bottom	5	9	7	16	3	6	13	14	7	10	13	30	3	7
Chi Square Values	5.65		22.67		11.45		2.13		6.15		45.53		9.91	
							IV - IM or AM							
Top	5	2	10	2	5	1	27	21	15	8	16	3	4	0
2nd	5	2	8	2	5	2	22	22	12	10	16	5	4	1
3rd	4	5	8	12	4	3	18	22	10	15	15	23	3	5
4th	4	4	7	7	3	8	15	13	8	8	14	14	3	3
Bottom	4	9	6	16	3	6	10	14	6	10	14	30	2	7
Chi Square Values	10.10		29.57		16.50		4.09		8.82		40.67		11.25	

*=Expected; O=Obtained

[1]A value of 13.277 is significant at the .01 level.

APPENDIX E

OBTAINING COMBINED DISTRIBUTION OF EXPECTED PERFORMANCE FROM PERCENTILE DISTRIBUTIONS ON AN INDEPENDENT VARIABLE FROM A NUMBER OF SAMPLES

APPENDIX E

Obtaining Combined Distribution of Expected Performance from Percentile Distributions on an Independent Variable from a Number of Samples

When a standard score conversion is not possible because of a lack of certain necessary information, an effective conversion can be obtained if the relative standing of the members of the samples to be combined is known.

The conversion can be made as refined as considered necessary; i.e., identifying the relative position of members of the separate samples in terms of unit percentages, tenths, fifths, or even halves. This can be done for both the independent and dependent variables if necessary, but it is better if the actual standing of the subject is available on the dependent variables. By converting the measurement of one variable to a standard score, a multiserial can then be computed between the independent variable (in standard score form).

An even more conservative estimate of the relationship between the independent and dependent variables can be obtained by computing a product-moment correlation between the raw scores (independent variable) and the converted dependent variable for all groups combined, as was done in this study. The obtained correlations are presented in Table 13.

Given the relative standings of the combined samples on the independent variable and the correlation between the independent and dependent variable, the predicted (expected) standing of the sample members on the dependent variable can be obtained by referring to the Tables made by Richard P.T. Scott (5) showing the predicted location of an individual in a dependent measurement from his standing in an independent one. Tables are available for all correlations from .05 to .95 in .05 intervals.

For this study, the table for an r of .35 was used. In Table 14, the distributions by fifths of the combined samples on SAT-V, is as follows:

Top fifth	51
2nd fifth	54
3rd fifth	66
4th fifth	83
5th fifth	62

From the Scott table, 34.65% of those in the top fifth on the independent variable can be expected to be in the top fifth in the dependent variable; 24.4% in the second fifth; 18.8% in the third; 13.95% in the fourth; and 8.2% in the bottom fifth. Similar percentages can be easily computed for those in each fifth on the independent measure. Once the N's are computed for all 25

cells of a 5 x 5 matrix, the sums of the columns provide the expected distributions on the dependent measure in fifths. The expected distributions obtained in this fashion are presented in Table 16, together with the actual (obtained) distributions.

A Chi Square test can be an appropriate test to apply to determine the significance of the differences between the expected and obtained distributions.

In the situation where the actual distribution or independent variable is lower than for the entire class (equal N's in each fifth) and the correlation with the dependent variable is positive, the expected distribution will shift up toward the mean. Hence the expected N in the top fifth is greater than the actual N in the top fifth in the independent variable for SAT-V. In those situations where the actual distribution on the independent variable is higher than for the entire class, and the correlation with the dependent variable is positive, the expected distribution will shift down toward the mean as is the case with SAT-M, EC, and I or AM (Table 12 and 14).